is heated, which expands the gas thereby increasing the pressure acting upon end **30** and extending TRS **56** across passage **68**.

[**0045**] Preferred embodiments of valves of the present invention include one or more elements configured to prevent leakage of a valve even when excess pressure acts upon the TRS obstructing the valve passage. Excess pressure occurs when the pressure present at one side of the valve is greater than the pressure present at the other side. For example, excess upstream pressure means that the pressure acting upon the upstream side of the valve from the upstream channel is greater than the pressure acting upon the downstream side of the valve from the downstream channel. Preferably, the at least one element is a surface that is disposed in opposition to a material transport path, which is the path taken by material passing through the open valve. When the valve is closed the excess upstream pressure urges the TRS against the opposed surface rather than causing leakage through the obstructed passage.

[**0046**] Returning to **FIG.** 2*a,* the TRS that obstructs passage **68**, extends from a reservoir **55** to a valve wall **72**. Reservoir **55** includes an amount of TRS **57** that is offset from passage **68** so that TRS **57** does not obstruct the passage of material through the valve. Reservoir **55** is preferably disposed on an opposite side of a passage central axis **63** from valve wall **72**. At least a first abutting portion **70** of TRS **56** abuts wall **72**. As used herein, the term "abuts" means that any remaining space between an abutting portion of a TRS and a wall of a closed valve is sufficiently small to substantially prevent the passage of material, such as a liquid, therethrough. Preferably, the portion of a TRS that abuts a wall, touches the wall, essentially eliminating the space therebetween.

[**0047**] Wall **72** includes a first opposed wall portion **74**, which is preferably disposed at an angle to passage central axis **51**. A second abutting portion **76** of TRS **56** abuts first opposed wall portion **74** when valve **50** is closed. Second abutting portion **76** and first opposed wall portion **74** substantially prevent passage of material through valve **50** even when the pressure acting upon an upstream portion **81** of TRS **56** exceeds the pressure applied to a downstream portion **78** of TRS **56**. Excess upstream pressure urges second abutting portion **76** against opposed wall surface **74**, thereby closing valve **50** more securely. In the absence of an opposed wall portion, excess upstream pressure can distort the configuration of a TRS obstructing a valve passage, which could permit the undesirable leakage of material through the valve.

[**0048**] First opposed wall portion **74** is preferably integral with a wall projection **80** that extends into a path taken by material passing through passage **68**. Thus, at least some material entering passage **68** via an upstream cross sectional area **66** must pass around projection **80**. For example, **FIGS.** 3*a* and 3*b* show that a material transport path **63** from an upstream point **62** into passage **68** is obstructed by opposed wall portion **74**. In general, a material transport path is the path taken by material, such as a sample and or reagent, in proceeding from an upstream location toward a downstream location. With respect to a particular valve, the terms upstream and downstream refer to the preferred direction of material transport through the valve. It should be understood, however, that a valve can be operated to permit or obstruct the passage of material from a downstream side of the valve to an upstream side.

[**0049**] Projection **80** includes a second opposed wall surface **86** and an outer wall **88**. A wall **90** of second channel **54** is disposed on the opposite side of central axis **61** from outer wall **88**. Because projection **80** extends beyond wall **72**, a distance **82** between outer wall **88** and wall **90** is smaller than a corresponding distance **84** between opposed walls of first channel **52** at upstream point **62**. Downstream distance **82** is at least 10% smaller, preferably at least 20% smaller, and more preferably at least 30% smaller than upstream distance **84**. Thus, projection **80** and wall **90** define a restriction, where a cross sectional area **67** of a downstream material transport path **59** is less than cross sectional area **66** of an upstream material transport path **58**. The smaller downstream cross sectional area adjacent the valve increases the capacity of valve **50** to withstand greater upstream pressure without excessive leakage. The presence of projection **80** also offsets a central axis **61** of second channel **54** from a central axis **60** of first channel **52**. Although projection **80** is shown as generally rectangular, alternative projections having other shapes such as triangular or shapes with arcuate surfaces can be used.

[**0050**] Valve **50** operates to open or close passage **68** upon a change of the temperature of TRS **56** from a first to a second, preferably higher temperature. Actuation of a heat source **37**, which is in thermal contact with at least a portion of TRS **56** and **57**, provides sufficient thermal energy to change a physical or chemical characteristic of the heated portion of TRS. Preferably, the change in characteristic is a softening or a decrease in size that is sufficient to allow a motion of at least TRS **56** with respect to passage **68**. Valve **50** can be repeatedly switched between the opened and closed states without a significant loss of material **56** or capacity to prevent passage of material through the valve when closed.

[**0051**] A temperature responsive material (TRS) refers to a material that exhibits a change in at least one physical or chemical characteristic upon a transition from a first temperature to a second, different temperature. The mass of TRS that obstructs a valve passage can be an essentially solid mass or an agglomeration of smaller particles that cooperate to obstruct the passage. Examples of TRS's include, but are not limited to solder, wax, polymers, plastics, and combinations thereof. Preferably, the characteristic is at least one of a decreased hardness and a decreased size. For example, in one embodiment, the TRS melts upon a transition from a first temperature to a second, higher temperature. The TRS that melts is a meltable substance that may be, for example, a wax (for example, an olefin) or a eutectic alloy (for example, a solder). The first and second temperatures are preferably insufficiently high to damage materials, such as nearby electronic components or the device substrate. The second temperature is preferably from 40° to 90° C. and most preferably from 50° to 70° C.

[**0052**] In a preferred embodiment, the TRS, does not disperse upon melting but merely softens. In an alternative embodiment, the TRS is a substance having a coefficient of thermal expansion that is different from the material forming the obstructed passage. Heating or cooling the passage and TRS causes the TRS to expand or contract relative to the passage. In the contracted state, the TRS can be actuated to move in or out of the channel, as described below.